

Shuttle Support Equipment

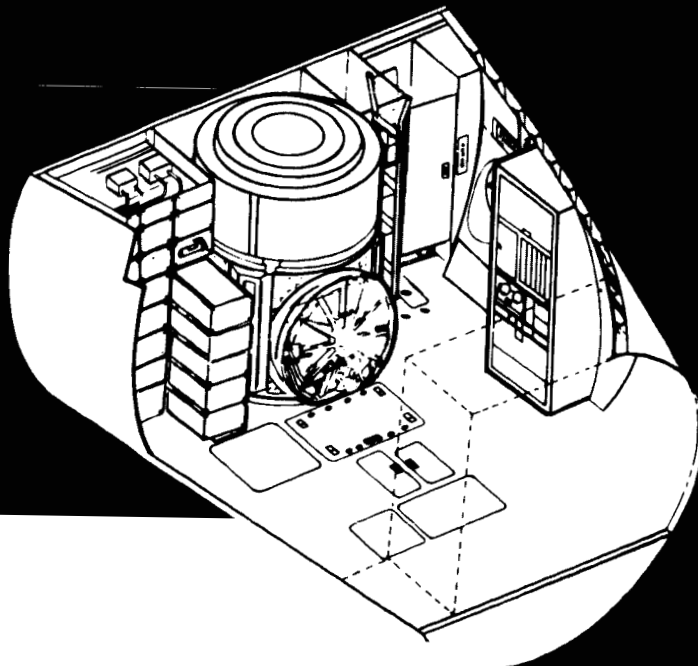
Life Sciences and
the Shuttle Program

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Foreword

The Shuttle Orbiter is a craft capable of operating in space for up to 4 weeks and, as such, is outfitted with essential life-sustaining systems. The Space and Life Sciences Directorate at the NASA Lyndon B. Johnson Space Center is responsible for certain systems and equipment that will ensure the health and safety of the crew, maintain their hygiene and relative comfort, and provide them with the basic needs for living and operating in a strange and artificial environment. These systems include the food system, complete with all equipment necessary to provide hot meals as well as snacks; medical kits, complete with drugs and containing some equipment for emergency treatment; operational bioinstrumentation; exercisers; atmospheric-monitoring equipment; anti-g suits; radiation dosimetry; and other associated equipment.

Many of these systems are being provided by the Shuttle Support Branch of the Life Sciences Projects Division. In addition, the ionizing radiation dosimetry system is provided by the Biomedical Applications Branch of the Medical Sciences Division. Acknowledgment is given to the Crew Training and Procedures Division of the Flight Operations Directorate for the description of some of the equipment.

This document is an overview of some of the various systems to be used in the orbital flight tests and operational flights and is not intended to provide detailed technical information.

James E. Bost
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Contents

1 Shuttle Orbiter Food Program

- 2 Galley
- 5 Flight Food
- 9 Food System Accessories
- 10 Food Warmer
- 11 Water Dispenser
- 12 OFT Meal Assembly Tray

13 Shuttle Biomedical Equipment

- 14 Operational Bioinstrumentation System
- 15 Anti-g Suit
- 16 Shuttle Orbiter Medical System
- 17 Teflon Treadmill Exerciser
- 18 Atmosphere Sampling
- 19 Ionizing Radiation Dosimetry System

Shuttle Orbiter Food Program

The Orbiter is equipped with food, food stowage, and food preparation and dining facilities to provide each crewman with three meals per normal onorbit day plus snacks and an additional 96 hours of contingency food. The food supply and food preparation facilities are designed to accommodate flight variations in the number of crewmen and flight durations ranging from two crewmen for 1 day to seven crewmen for 30 days.

The food preparation equipment for use in orbital flight tests (OFT's) and operational (OPS) flights consists of the following.

Equipment	Type of flight
Galley and personal hygiene station	OPS
Food	OFT and OPS
Food system accessories	OFT and OPS
Food warmer	OFT
Water dispenser	OFT
Food trays	OFT and OPS

The galley is located in the Orbiter cabin (fig. 1) and is mounted to the mid-deck floor and wall at the port side forward of the side hatch. It interfaces directly with the Orbiter electrical power system and the ambient and chilled potable water system. The galley is modular and can be moved for special missions.

The galley provides a centralized location for one individual to handle all food preparation activities for a meal (fig. 2). It contains, in one compact unit, stowage for pantry food items, food system accessories, and food trays. The galley also has facilities for food heating, water dispensing, and personal hygiene.

The pantry, which makes up the upper portion of the galley, is an onorbit stowage compartment for food-related items. The interior of the pantry contains restraints to hold meal assembly trays during launch, reentry, and onorbit operations.

The oven, located in the mid section of the galley, can accommodate 14 rehydratable packages and 8 thermostabilized food packages at one time. The rehydratable food packages are heated by convection (fans located behind the oven evenly distribute heat within the interior) and the thermostabilized food packages are heated by conduction. The oven has a heating range of 335 to 360 K (65° to 85° C or 145° to 185° F).

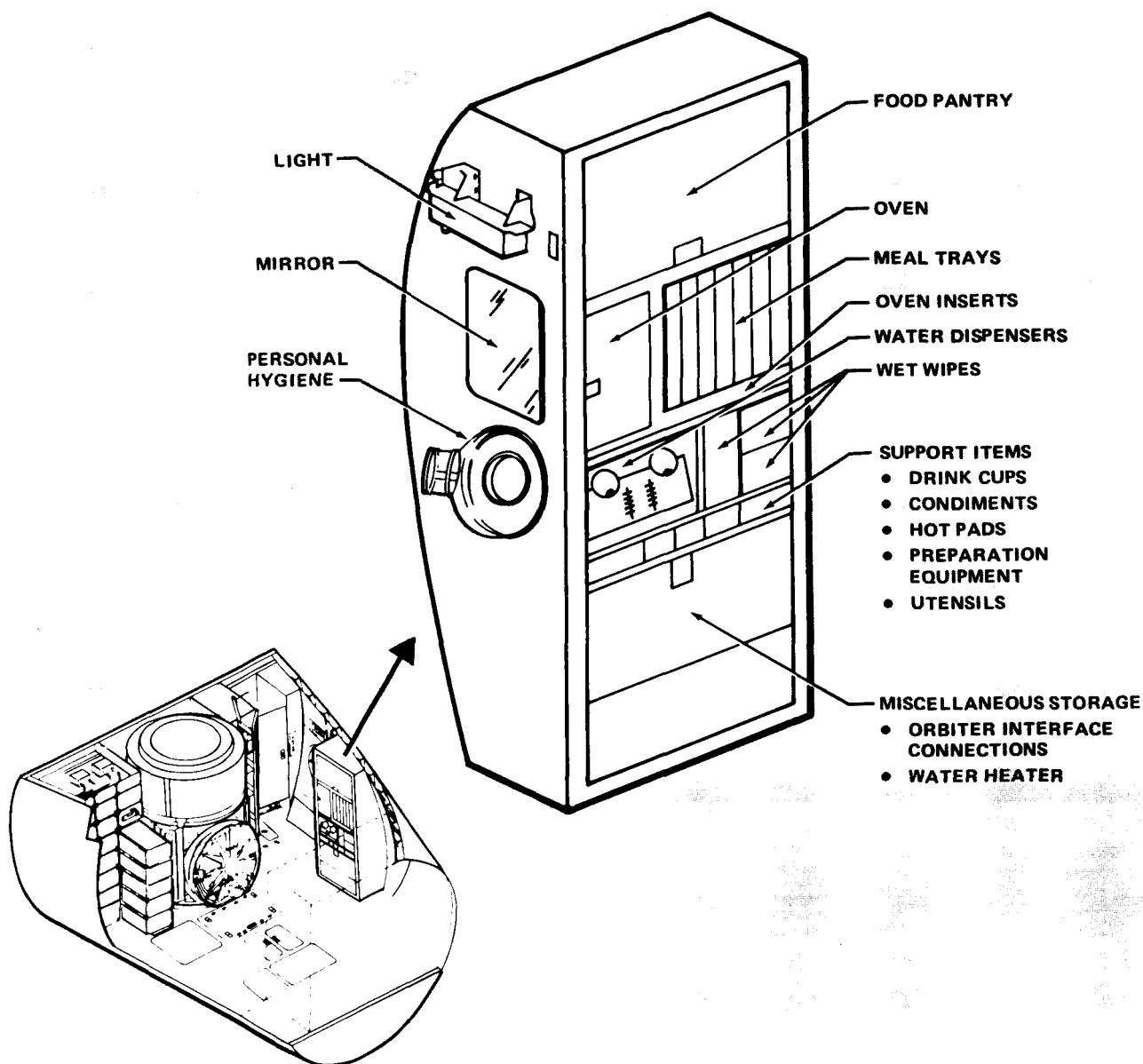


Figure 1.—Galley configuration (concept).

The galley has a hot and chilled water dispenser system with temperatures ranging from 285 to 345 K (10° to 70° C or 50° to 160° F). The dispenser provides 30 to 240 milliliters (1 to 8 ounces) of water at any usage in 14.8-milliliter (0.5-ounce) increments. For food reconstitution, the dispenser needle is inserted through the rubber septum provided on rehydratable food containers.

The galley is also equipped with a water heater, which supplies the galley water dispenser and the personal hygiene station (PHS) dispenser. The water heater draws ambient water from the Orbiter ambient potable water system. The heater has a 5.4-kilogram (12-pound) capacity and can provide a hot water supply at a temperature of up to 345 K (70° C or 160° F).

When the galley is not flown, the personal hygiene station is located on the left side of the mid deck and provides ambient and chilled water through a flexible line to a water dispenser. No drain is provided. When the galley is flown, the personal hygiene station is located on the left side of the mid deck and provides ambient and hot water plus a drain (fig. 3). The personal hygiene station (fig. 4) consists basically of the hygiene water dispenser and includes a handwashing enclosure, a mirror, a light, a soap dispenser, and controls for water dispensing, draining, and temperature adjustment.

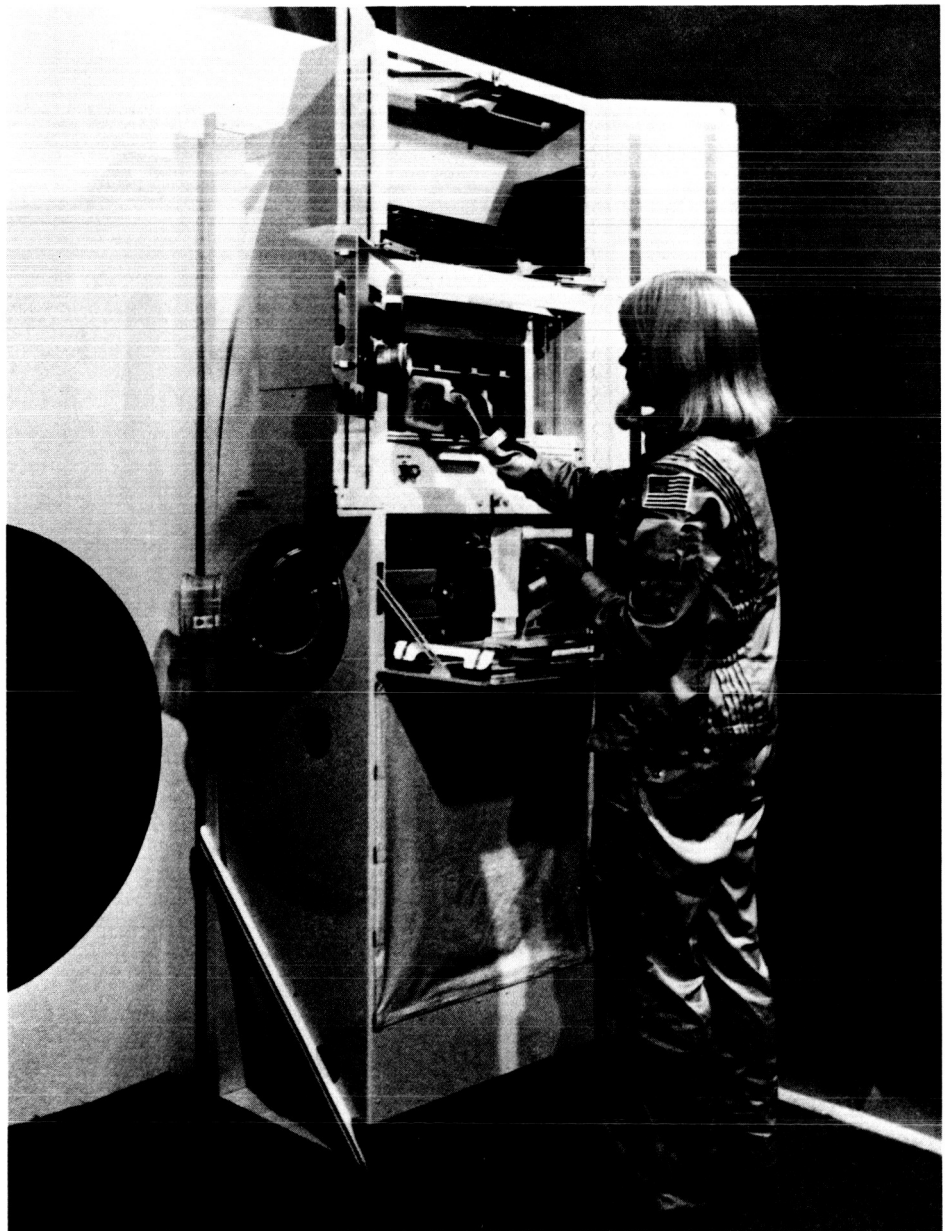


Figure 2.—Galley.

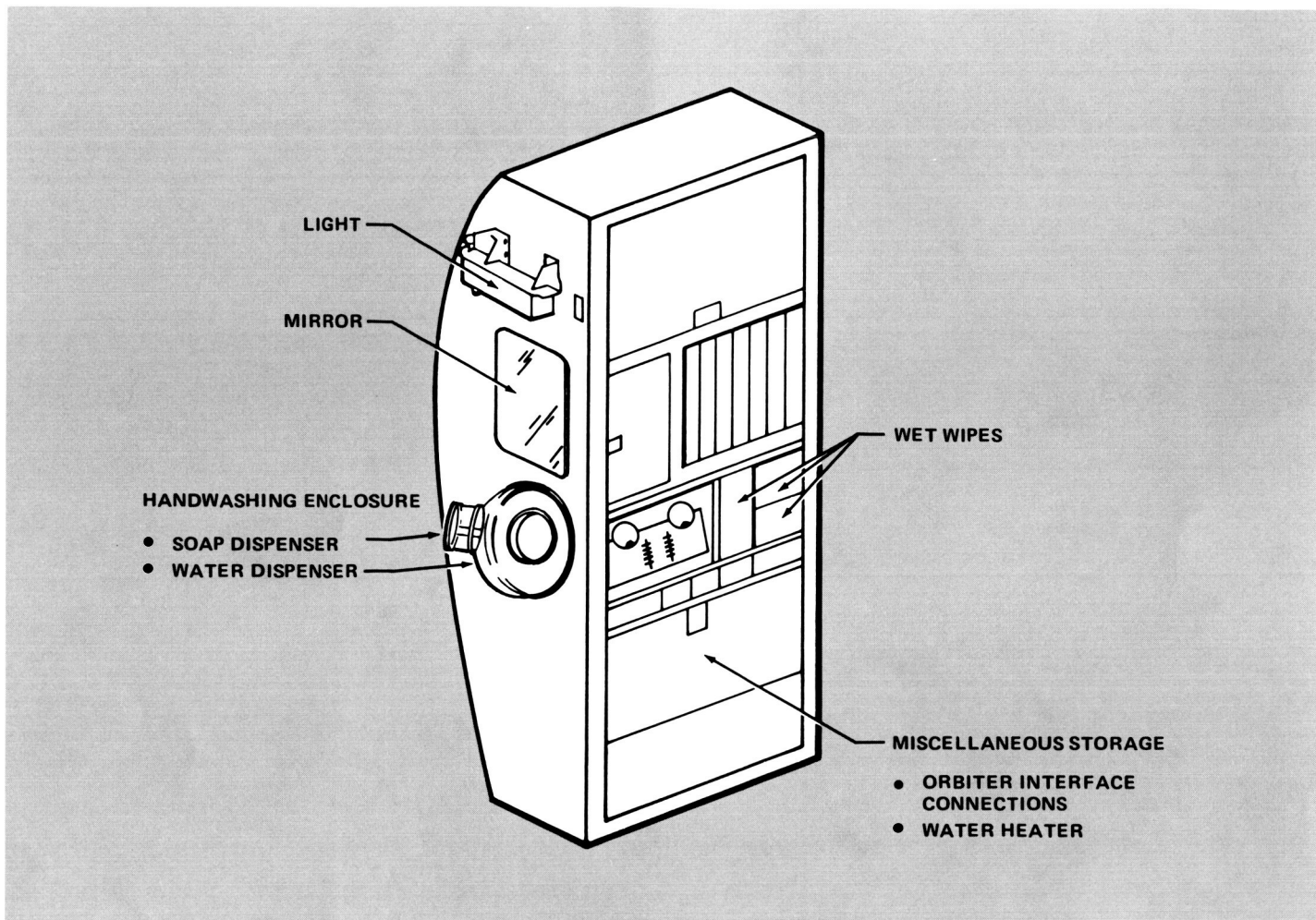


Figure 3.—Personal hygiene equipment on orbit locations (with galley).



Figure 4.—Personal hygiene station.

Flight Food

Project Engineer: Richard Sauer
Food Technologist: Rita Rapp

The two categories of food supplies are the menu food supply (table I), which is designed to provide an average energy intake of 3000 calories per crewman per day, and the pantry food supply, which contains snack items and a 4-day contingency food supply (fig. 5). The contingency food is designed to provide 2100 calories per man-day. Table II lists the food items that are qualified for flight and will be used for orbital flight tests. A slightly larger list will be used to support operational flights.

The menu food items for a man-day consist of approximately 20 packages.

- 4 to 7 rehydratables
- 1 to 4 thermostabilized/irradiated
- 8 beverages
- 4 ready to eat
- 3 hot items per man-meal (maximum)

Thermostabilized foods are packaged in cans or flexible pouches. The cans are of various sizes and are configured for opening either with easy-open full-panel pullout lids or with a can opener. Food is eaten directly out of the can using eating utensils. The pouches are cut open with scissors and the food eaten directly from the package. Each package is clearly marked with its contents.

Rehydratable foods used on OFT flights are packaged in containers that interface with the water dispenser. Both the food container and the beverage container have rehydration valves. The beverage container (fig. 6) consists of a plastic bellows body with a tube for drinking. It has a 5.92-centimeter (2.33-inch) diameter and is approximately 23 centimeters (9 inches) long when extended and 8 centimeters (3 inches) long when compressed. The food container, called a spoonbowl package, is rehydrated through the one-way water valve. Food is eaten with a spoon through the top of the package after cutting an opening with scissors (fig. 7).

TABLE I.—SPACE SHUTTLE TYPICAL MENU^a

Day 1	Day 2	Day 3	Day 4
Peaches (T) Beef patty (R) Scrambled eggs (R)	Applesauce (T) Beef jerky (NF) Granola (R)	Dried peaches (IM) Sausage (R) Scrambled eggs (R)	Dried apricots (IM) Breakfast roll (I) (NF) Granola w/blueberries (R) Vanilla instant breakfast (B) Grapefruit drink (B)
Bran flakes (R)	Breakfast roll (I) (NF)	Cornflakes (R)	
Cocoa (B) Orange drink (B)	Chocolate instant breakfast (B) Orange-grapefruit drink (B)	Cocoa (B) Orange-pineapple drink (B)	
Frankfurters (T) Turkey tetrazzini (R) Bread (2) (I) (NF)	Corned beef (T) (I) Asparagus (R) Bread (2) (I) (NF)	Ham (T) (I) Cheese spread (T) Bread (2) (I) (NF)	Ground beef w/ pickle sauce (T) Noodles and chicken (R) Stewed tomatoes (T) Pears (FD) Almonds (NF) Strawberry drink (B)
Bananas (FD) Almond crunch bar (NF) Apple drink (2) (B)	Pears (T) Peanuts (NF) Lemonade (2) (B)	Green beans and broccoli (R) Crushed pineapple (T) Shortbread cookies (NF) Cashews (NF) Tea w/lemon and sugar (2) (B)	
Shrimp cocktail (R) Beef steak (T) (I)	Beef w/barbeque sauce (T) Cauliflower w/cheese (R)	Cream of mushroom soup (R) Smoked turkey (T) (I)	Tuna (T) Macaroni and cheese (R) Peas w/butter sauce (R) Peach ambrosia (R) Chocolate pudding (T) (R) Lemonade (B)
Rice pilaf (R) Broccoli au gratin (R) Fruit cocktail (T)	Green beans w/mushrooms (R) Lemon pudding (T) Pecan cookies (NF)	Mixed Italian vegetables (R) Vanilla pudding (T) (R) Strawberries (R)	
Butterscotch pudding (T) Grape drink (B)	Cocoa (B)	Tropical punch (B)	

^aAbbreviations in parentheses indicate type of food: T = thermostabilized, I = irradiated, IM = intermediate moisture, FD = freeze dried, R = rehydratable, NF = natural form, and B = beverage.

Food items for each individual meal are packaged together in food overwraps and stowed in the mid-deck lockers before a flight. During flights without a galley, all food is stowed in mid-deck forward lockers. On flights with a galley, all food is stowed in mid-deck forward lockers for launch and reentry. Unused food items remain there throughout the flight. Pantry food items are moved to the galley pantry for onorbit activities.

When the galley is installed on the Orbiter, a new packaging system will be introduced. The new package consists of an injection-molded high-density polyethylene base coated with Saran and a thermoformed flexible lid made from a Saran-coated polyethylene film (fig. 8). The new package will replace both the rehydratable spoonbowl package and the beverage package. The new package uses a needle-septum concept for the addition

of water. The one-piece septum replaces the nine-piece one-way valve used in previous systems. The package interfaces with the galley rehydration device, which automatically injects a preset volume of hot or chilled water into the package. Beverages and water are consumed through a polyethylene straw connected to tubing that is inserted through the same septum used for rehydration. A plastic clamp is attached to the tubing for closing the straw when not in use.

TABLE II.— SPACE SHUTTLE FOOD AND BEVERAGE LIST

Foods ^a		
Applesauce (T)	Chicken and noodles (R)	Peaches, dried (IM)
Apricots, dried (IM)	Chicken and rice (R)	Peaches (T)
Asparagus (R)	Chili mac w/beef (R)	Peanut butter
Bananas (FD)	Cookies, pecan (NF)	Pears (FD)
Beef almondine (R)	Cookies, shortbread (NF)	Pears (T)
Beef, corned (I) (T)	Crackers, graham (NF)	Peas w/butter sauce (R)
Beef and gravy (T)	Eggs, scrambled (R)	Pineapple, crushed (T)
Beef, ground w/pickle sauce (T)	Food bar, almond crunch (NF)	Pudding, butterscotch (T)
Beef jerky (IM)	Food bar, chocolate chip (NF)	Pudding, chocolate (R) (T)
Beef patty (R)	Food bar, granola (NF)	Pudding, lemon (T)
Beef, slices w/barbeque sauce (T)	Food bar, granola/raisin (NF)	Pudding, vanilla (R) (T)
Beef steak (I) (T)	Food bar, peanut butter/granola (NF)	Rice pilaf (R)
Beef stroganoff w/noodles (R)	Frankfurters (Vienna sausage) (T)	Salmon (T)
Bread, seedless rye (I) (NF)	Fruitcake	Sausage patty (R)
Broccoli au gratin (R)	Fruit cocktail (T)	Shrimp creole (R)
Breakfast roll (I) (NF)	Green beans, french w/mushrooms (R)	Shrimp cocktail (R)
Candy, Life Savers, assorted flavors (NF)	Green beans and broccoli (R)	Soup, cream of mushroom (R)
Cauliflower w/cheese (R)	Ham (I) (T)	Spaghetti w/meatless sauce (R)
Cereal, bran flakes (R)	Jam/jelly (T)	Strawberries (R)
Cereal, cornflakes (R)	Macaroni and cheese (R)	Tomatoes, stewed (T)
Cereal, granola (R)	Meatballs w/barbeque sauce (T)	Tuna (T)
Cereal, granola w/blueberries (R)	Nuts, almonds (NF)	Turkey and gravy (T)
Cereal, granola w/raisins (R)	Nuts, cashews (NF)	Turkey, smoked/sliced (I) (T)
Cheddar cheese spread (T)	Nuts, peanuts (NF)	Turkey tetrazzini (R)
Chicken a la king (T)	Peach ambrosia (R)	Vegetables, mixed Italian (R)
Beverages		Condiments
Apple drink	Instant breakfast, vanilla	Barbeque sauce
Cocoa	Lemonade	Catsup
Coffee, black	Orange drink	Mustard
Coffee, w/cream	Orange-grapefruit drink	Pepper
Coffee, w/cream and sugar	Orange-pineapple drink	Salt
Coffee, w/sugar	Strawberry drink	Hot pepper sauce
Grape drink	Tea	Mayonnaise
Grapefruit drink	Tea w/lemon and sugar	
Instant breakfast, chocolate	Tea w/sugar	
Instant breakfast, strawberry	Tropical punch	

^a Abbreviations in parentheses indicate type of food: T = thermostabilized, I = irradiated, IM = intermediate moisture, FD = freeze dried, R = rehydratable, and NF = natural form.

Although the new package will result in an increase in weight — 31.3 grams (1.1 ounces) compared to 17.2 grams (0.6 ounce) for the spoonbowl and 27.5 grams (1.0 ounce) for the Skylab beverage package — packaging costs have been reduced. The system has fewer parts (3 compared to 19 for the spoonbowl), uses more readily available materials, and has most of the production steps automated. Earlier packages were labor intensive with many of the fabrication and assembly steps done by hand.

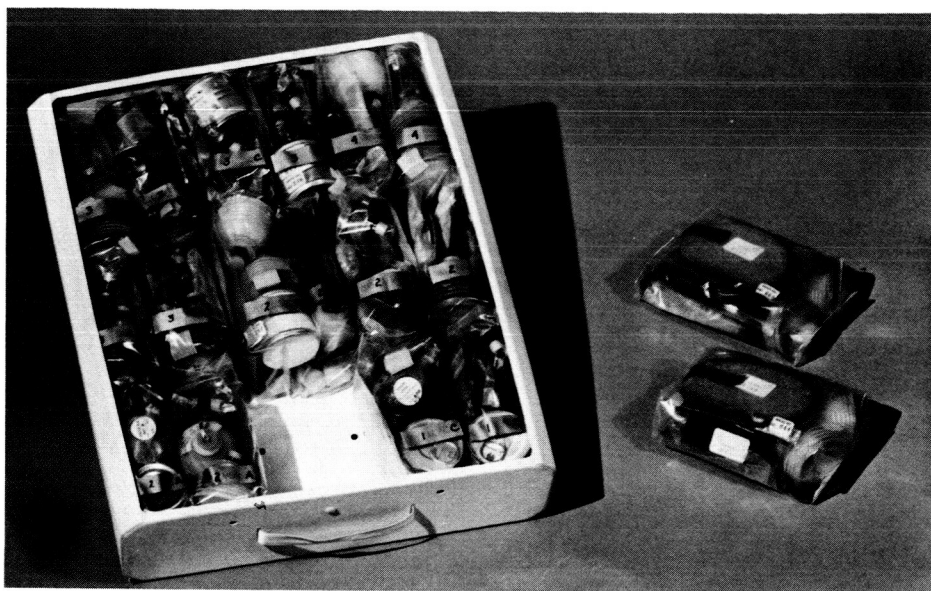


Figure 5.—OFT 1 food system mockup (day 1 meal B through day 4 meal A).

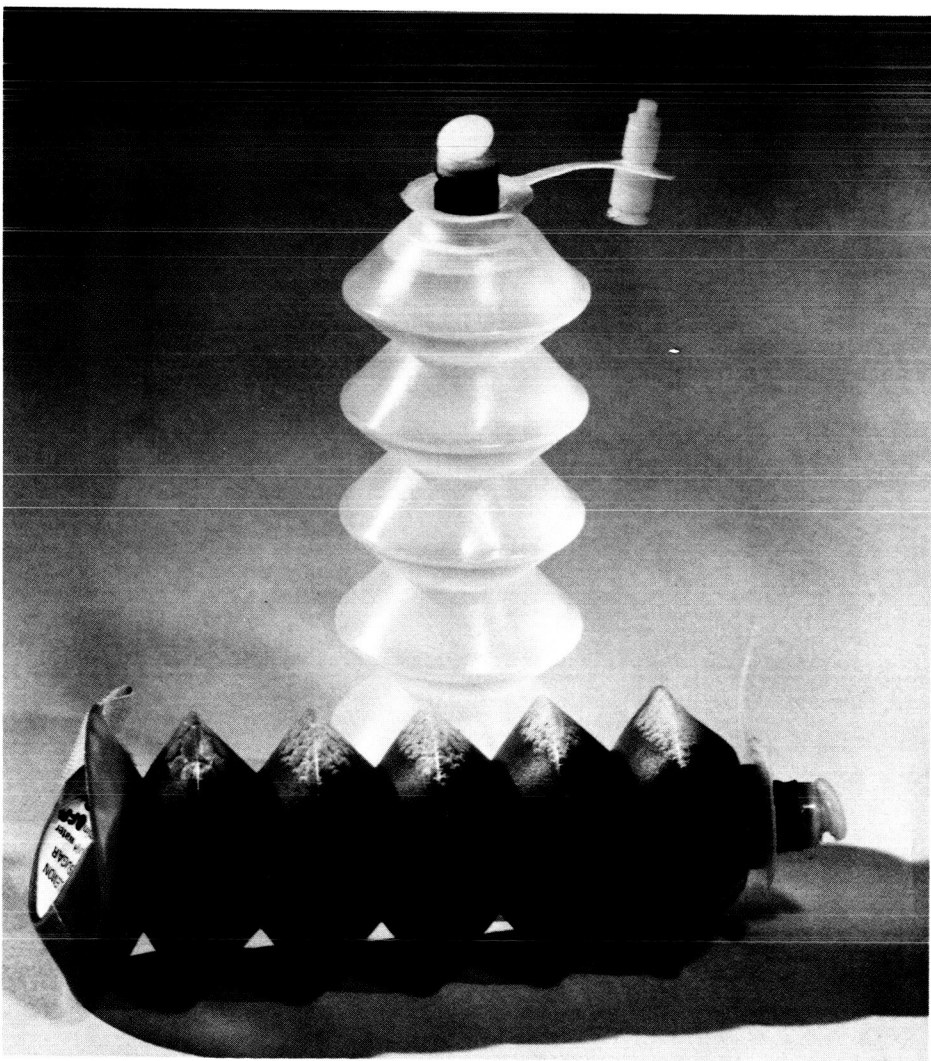


Figure 6.—Beverage container.



Figure 7.—Spoonbowl package.

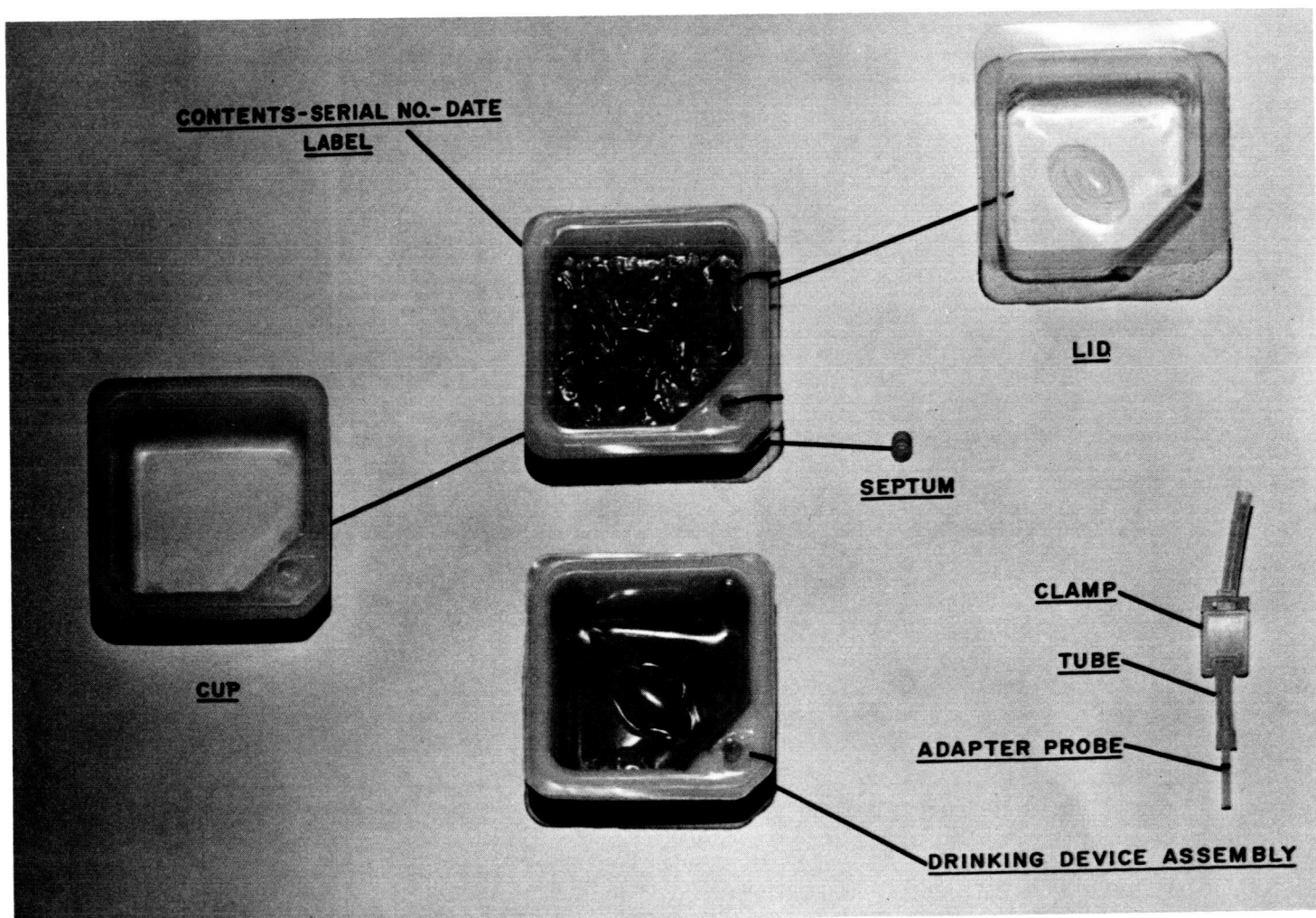


Figure 8.—Packaging system designed to replace the beverage container and the spoonbowl package.

Food System Accessories

Food system accessories include a variety of items that are used during food preparation or during dining (fig. 9).

Condiments — hot pepper sauce, catsup, mayonnaise, mustard, etc., which are packaged in individual sealed pouches of flexible plastic laminates, and liquid salt and pepper, which are dispensed from polyethylene dropper bottles

Snacks — candy and gum

Vitamins

Wet wipes — used in cleaning utensils after dining (packaged 21 per OFT dispenser)

Dry wipes — used in dining and postdining cleanup (packaged 36 per OFT dispenser)

Utensils — a knife, two spoons (large and small), a fork, scissors, and a can opener for each crewmember

Thermal pads — used for handling hot food items from the galley

Drinking water containers — two full containers, which can be refilled from the water dispenser

For flights without a galley, the food system accessories are stowed in mid-deck forward lockers. When a galley is flown, the accessories can be stowed in either the galley or the lockers.



Figure 9.—Food system accessories kit.

Food Warmer

Project Engineer: William Young

The food warmer (fig. 10(a)) is the portable heating unit that is used when the galley is not flown. A typical meal for four crewmen — i.e., eight packages of thermostabilized or rehydratable food (fig. 10(b)) and four cans and four beverages (fig. 10(c)) — can be warmed in this unit in 2 hours. The warmer heats food items by thermal conduction and can be used to heat foods to 370 K (75° C or 170° F).

The outer case of the food warmer is 33 by 46 by 15 centimeters (13 by 18 by 6 inches); it is constructed of aluminum and has a zero-g hinge. The inner surface of the case is lined with urethane foam insulation. A heating element, consisting of a platen of laminated plastic and a cover of aluminum material, provides a thermostatically controlled heating capacity within the 350 K (75° C or 170° F) range when the spacecraft ac power is applied.

The warmer contains one control (an on/off switch) and one display (a power-on indicator light) on the exterior of the case.

Power is supplied to the food warmer by a power cable provided with the warmer. The cable is stowed inside the case during launch and reentry.

The food warmer is stowed for launch and reentry in a mid-deck forward locker. For onorbit operation, the warmer can be restrained on any convenient locker using a strap restraint system or attached to alternate sites by Velcro.



Figure 10.—Food warmer.

Water Dispenser

Project Engineer: Thomas Turner

The water dispenser is a compact system that provides the crew with ambient and chilled water for food rehydration, drinking, and hygiene. It interfaces with the Orbiter ambient and chilled potable water system (fig. 11). The water dispenser provides ambient water from 290 to 295 K (20° to 25° C or 65° to 75° F) and chilled water from 280 to 285K (10° to 15° C or 45° to 55° F) directly from the Orbiter water lines. The system consists of a housing assembly, a water dispenser, and two flexible lines.

The water dispenser housing assembly is a 32.39- by 21.84- by 8.26-centimeter (12.75- by 8.6- by 3.25-inch) aluminum cover encasing the water dispenser components. The housing assembly is secured to the vehicle wall-mounted bracket by two straps and is connected to the Orbiter potable water system by two flexible lines.

The water dispenser attaches to the food preparation hose and has a handgrip with a trigger at its top end and a 6.1-centimeter (2.4-inch) long barrel that interfaces directly with the rehydration valve on each rehydratable and beverage food container. Actuation of the trigger provides a jet of water out of the barrel. The temperature is controlled by a three-position manual valve.

Two flexible lines protrude out of the housing: one for the water dispenser and the other a two-position manual valve for the hygiene station. These lines are 46 centimeters (18 inches) long and are held to the housing when not in use by two clips.

The system contains three microbial filters: one for the hygiene dispenser line and one each for the water dispenser ambient and chilled water lines. The filters prevent water system contamination through back contamination from the use ports.

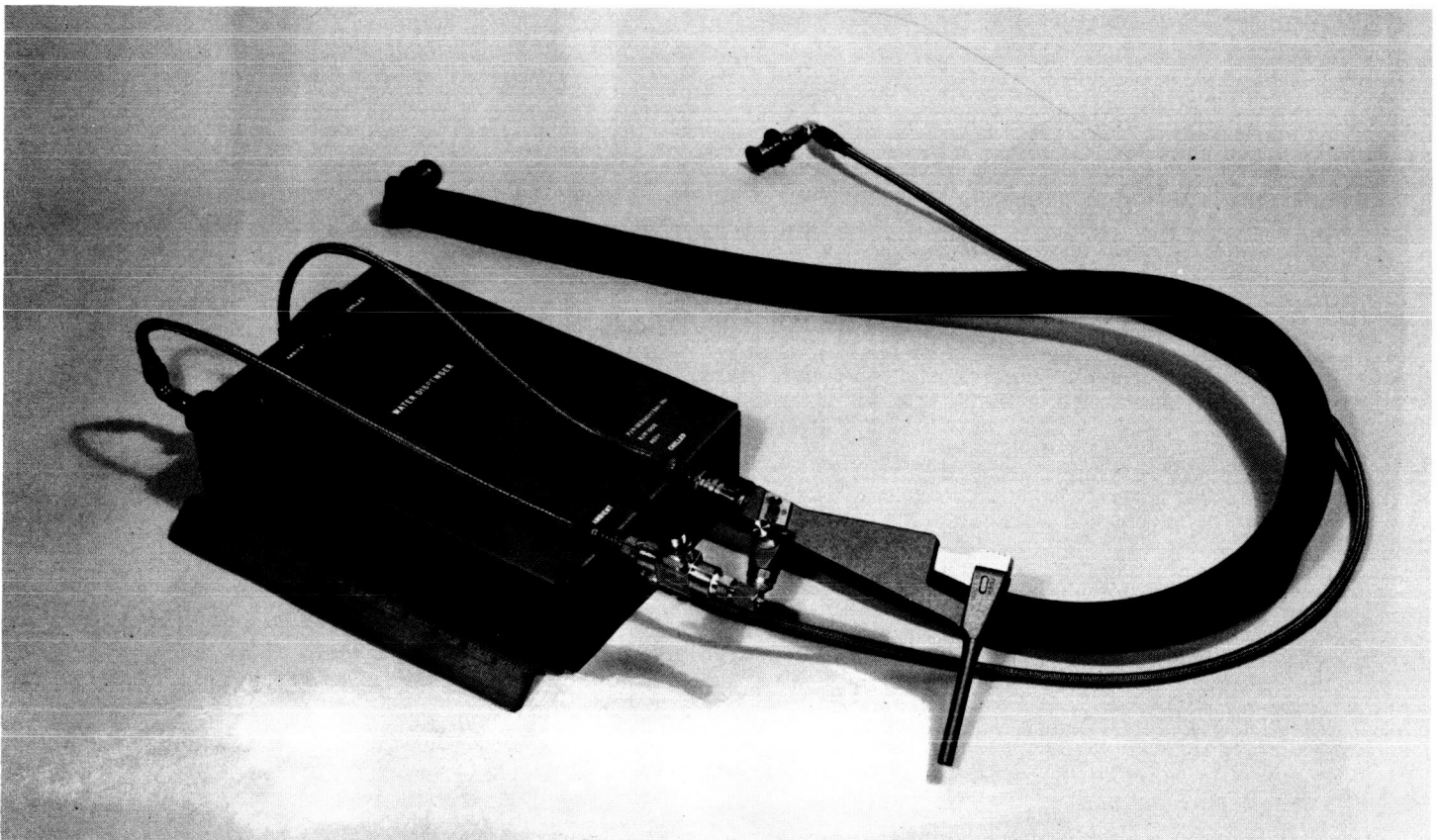


Figure 11.—Orbiter potable water system.

OFT Meal Assembly Tray

Project Engineer: Thomas Turner

The food tray system is composed of food trays designed to restrain food items and U-shaped brackets that secure the food tray to a locker (fig. 12).

The food tray is a 26.4- by 36.8- by 1.27-centimeter (10.4- by 14.5- by 0.50-inch) aluminum plate with Velcro patches and steel spring bungees, which serve as restraints for individual food packages and meal accessories in a zero-g environment.

The U-shaped bracket allows a crewman to secure the food tray to the top side of a forward mid-deck locker. The bracket is shaped such that one end rests on the edge of the food tray while the other end lies between the locker and its door. By fastening down the two launch locks on the locker door, the U-shaped bracket firmly anchors the food tray to the locker and provides a stable semipermanent eating surface that does not interfere with locker opening and closing or protrude into the crew operational area.

For launch and reentry, the food trays are stowed in a mid-deck forward modular locker.

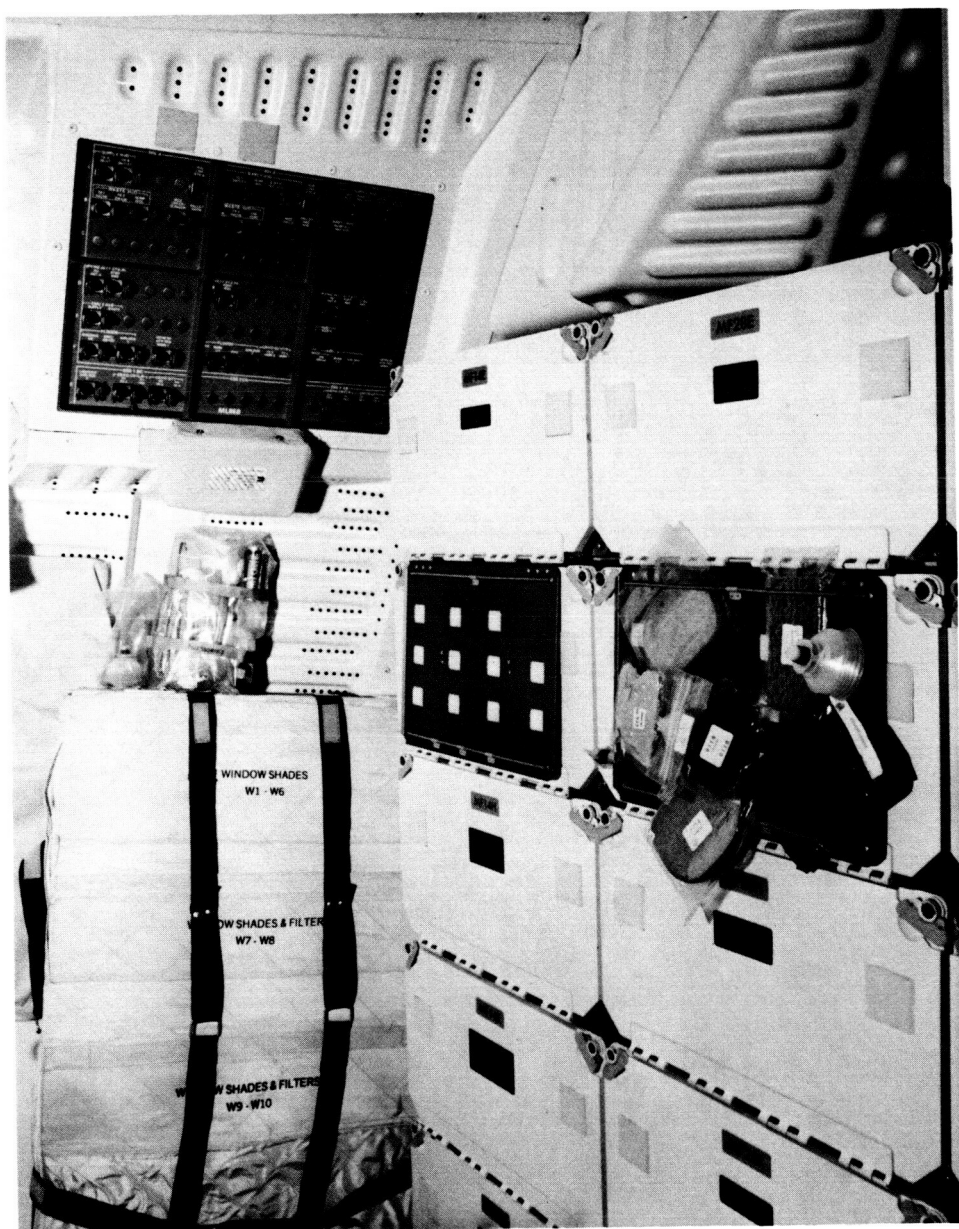


Figure 12.—Food tray system.

Shuttle Biomedical Equipment

The medical and biomedical systems discussed in this section have been designed to support specific crew habitability aspects of the Orbiter and to obtain operational biomedical data. These medically oriented systems are not intended for use in support of experiments.

The Shuttle Program is oriented to be a multimission program and will require different biomedical equipment for each mission. The Shuttle biomedical equipment addressed in the following sections consists of (1) the operational bioinstrumentation system, (2) the anti-g suit, (3) the Shuttle Orbiter medical system, (4) the Teflon treadmill exerciser, and (5) the atmosphere sampling system.

Operational Bioinstrumentation System

Project Engineer: William Young

The operational bioinstrumentation system (OBS) is used on all flights during prelaunch, launch, and reentry. Onorbit use is limited to extravehicular activity (EVA) unless intravehicular activity (IVA) use is requested by the flight surgeon.

The OBS provides an amplified electrocardiograph (ECG) analog signal from any two designated crewmembers onboard the Shuttle to the Shuttle avionics, where it is transmitted to the ground in real time or stored on tape for *dump* or *postflight* return. The major components of the system are a sternal electrode harness with three ECG electrodes, a battery-operated ECG signal conditioner, and appropriate cables to conduct an ECG signal from the crewmember to the onboard telemetry or to the onboard recorder. Different cables are provided to allow the OBS to be used in the ejection suit or the EVA suit or when in the shirt-sleeve environment of the Shuttle Orbiter (fig. 13).

Three electrodes are placed on the skin in the standard OBS configuration (one sternal, one right chest, and one lateral lead position). Each of the three electrodes connects to the amplifier through an electroshock protection circuit. Rather than using an on/off switch for the signal conditioner, the unit is actuated when output connectors are mated.

For flights in which the crewmembers wear pressure suits, the OBS cables are routed through the crewmember's constant-wear garments and ejection seat and restrained to the pressure suit and seat. For shirt-sleeve flights, the OBS is routed through the crewmember's constant-wear garment and flight suit and restrained to the flight suit and seat.

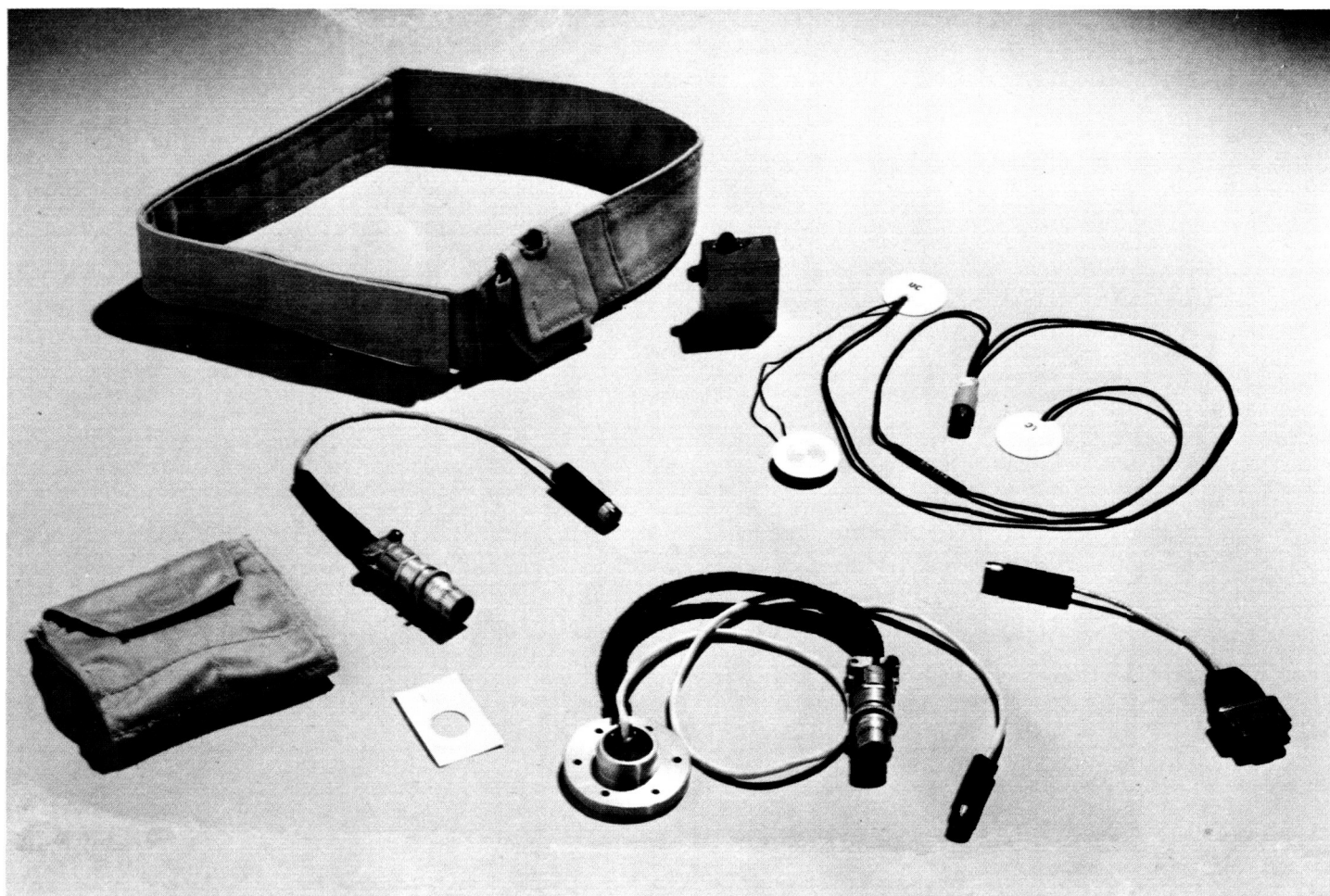


Figure 13.—Operational bioinstrumentation system.

Anti-g Suit

Project Engineer: Cletis Booher

The anti-g suit (AGS) is a one-piece self-donning garment extending from the ankles to the abdomen. It is designed to be worn by Shuttle crewmembers on flights exceeding 12 hours duration. The purpose of the AGS is to prevent degrading fluid shifts to the lower extremities during prolonged exposure to entry g loadings. Such fluid shifts, if allowed to occur, can cause a temporary disabling of crewmembers during critical entry and landing mission phases.

The AGS is a zippered wraparound garment that incorporates inflatable bladders, one over the abdomen and one over each thigh and calf (fig. 14). The garment has laces to allow sizing adjustment in the waist, thigh, and calf areas. The bladders are inflated by means of a small adjustable regulator located on the left side of the suit at the waist. Oxygen is fed to this regulator from the personal oxygen system located on each crewmember's seat. The regulator is infinitely adjustable from 0 to 17.2 kN/m² (0 to 2.5 psig), with "click stop" detents at each 3.5-kN/m² (0.5-psig) increment.

On selected later flights when more than three crewmembers are on board, payload specialists wearing the AGS will be monitored to measure specific physiological parameters. The instrumentation package will be battery powered and portable and will include the following:

1. An automatic blood pressure measurement system using an occlusion cuff with a built-in Korotkoff sound microphone to be located over the brachial artery
2. A cranial blood-flow measurement system using a Doppler sensing technique, with the sensor for this measurement placed on either side of the head just in front of the ear
3. The ECG subsystem using the standard sternal electrode configuration described for the Shuttle operational bioinstrumentation system
4. A phonocardiograph detection system, which will measure precordial heart sounds using a microphone-type

transducer mounted on each crewmember's chest at the point of maximum precordial movement

5. The AGS bladder-pressure measurement subsystem, which will

monitor the pressure level within the AGS bladders using the pressure transducer

The data collected will be recorded on a self-contained cassette tape recorder over a 2-hour operating period.

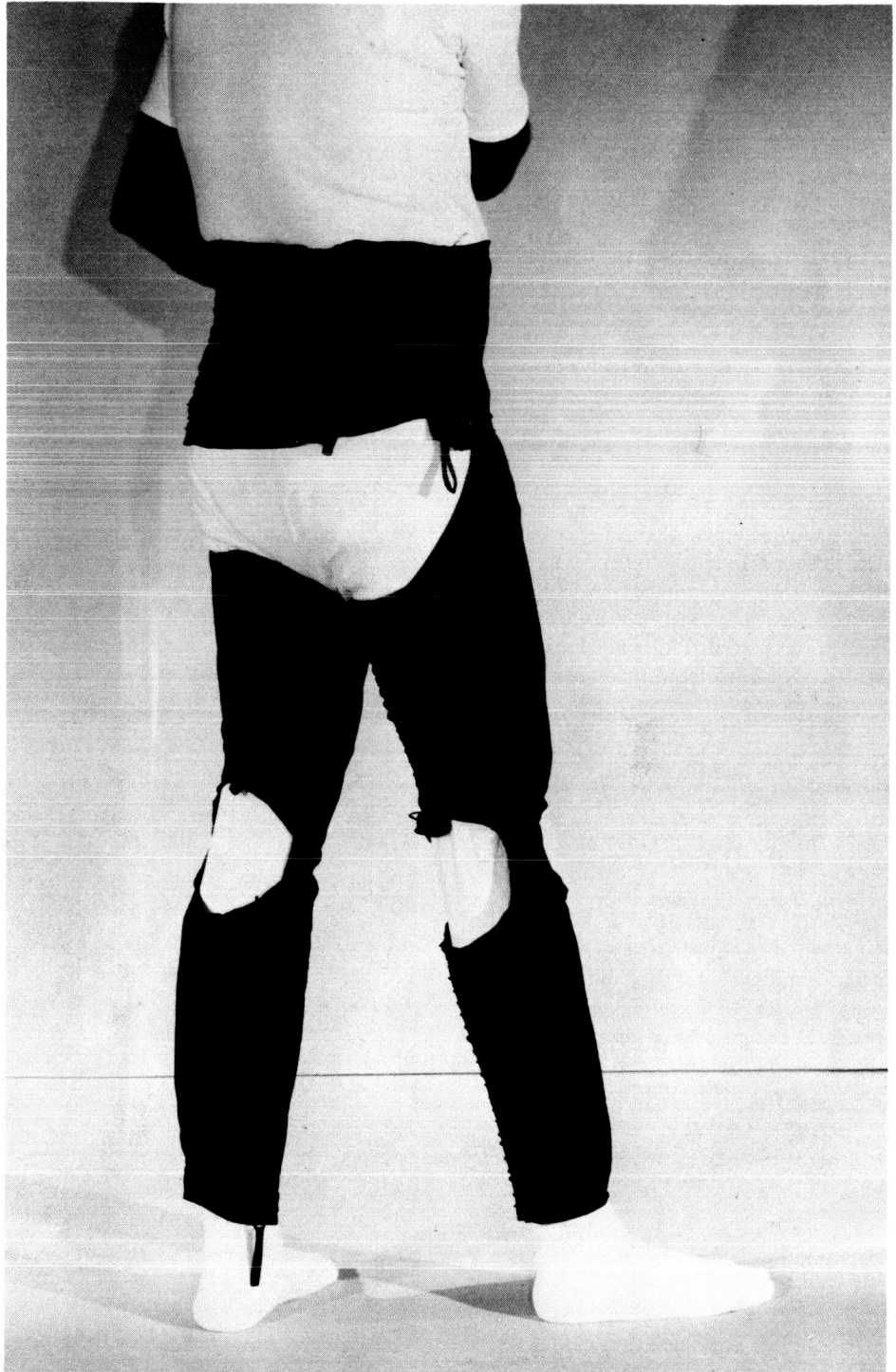


Figure 14.—Anti-g suit.

Shuttle Orbiter Medical System

Project Engineer: Richard Sauer

The Shuttle Orbiter medical system (SOMS) has provisions for medical care for minor illnesses and injuries as well as for stabilizing severely injured or ill personnel until return to Earth. Diagnostic equipment and information will allow diagnosis and treatment of injuries and illnesses through consultation with flight surgeons in the Mission Control Center.

The SOMS will contain equipment for medical care for a variety of medical problems (for example, small wounds or minor lacerations, minor burns, fractures, sprains, emergency airway restoration, infectious diseases, and treatment of injuries caused by increased physical activity). The SOMS will also include appropriate medical support for the various types of Shuttle flights.

SOMS kits are available for use onorbit for all flights. Proper medical coverage for the various kinds of Shuttle flights will be provided by SOMS-A and SOMS-B.

The SOMS-A (fig. 15) will be provided for short-duration flights. The SOMS-A weighs 4 kilograms (9 pounds) and contains two kits: the emergency medical kit (EMK) and the medications and bandage kit (MBK). The EMK (fig. 16) includes items for diagnosis (clinical thermometer, stethoscope, blood pressure cuff) and therapeutic items (tourniquet, oral airway). The MBK contains bandages and medications (pills, topicals, ointments).

The SOMS-B will be provided for longer duration flights and for flights where personnel are of questionable medical status. The SOMS-B has a greater medical capability than the SOMS-A in that it contains the items in SOMS-A (the EMK and the MBK) plus a defibrillator, an intravenous fluids system, and a positive-pressure oxygen regulator device. SOMS-B will be used for most flights.

Each pack is constructed in the form of a pallet with a fabric-covered stiffener and pockets on each side. The kits weigh less than 8 kilograms (18 pounds).

Each SOMS kit is designed to allow flexibility for selecting appropriate medical items in kit and module forms to accommodate specific flight requirements. The SOMS is packaged to allow quick access to emergency medication and instruments.

The SOMS is stowed in an Orbiter forward locker in the mid deck. For onorbit use, the kit may be attached with Velcro to any locker door.



Figure 15.—Shuttle Orbiter medical system A.



Figure 16.—Emergency medical kit.

Teflon Treadmill Exerciser

Project Engineer: Al Shannon

The only "off-duty" equipment for the early flights is an exerciser called the treadmill. The treadmill is an inflight exerciser used to minimize muscle loss in the legs and to maintain cardiovascular fitness in a zero-g environment.

The treadmill exerciser (fig. 17) consists of the treadmill, a waistbelt, force cords, shoulder straps, and fittings.

The treadmill is a three-piece hinged aluminum-alloy plate 30.5 by 69.8 centimeters (12.0 by 27.5 inches), with four attach points that protrude from the base. A Teflon sheet covers the face of the plate on which a stocking-footed crewmember will walk or jog in place during the exercise operations.

A foam-padded waistbelt has straps with rings for the attachment of shoulder straps and force cords.

Four force cords are connected to the waistbelt and treadmill creating tension on the crewmember. The tension can be adjusted by increasing or decreasing the cord length.

Two foam-padded shoulder straps are donned over the crewmember's shoulders. The shoulder straps are attached to the waistbelt and, along with the restraint system, hold the crewmember against the treadmill.

Four ring fittings are used to hold the treadmill in place on the mid-deck floor. The top of each fitting has a ring to accept the force-cord hook fastener.

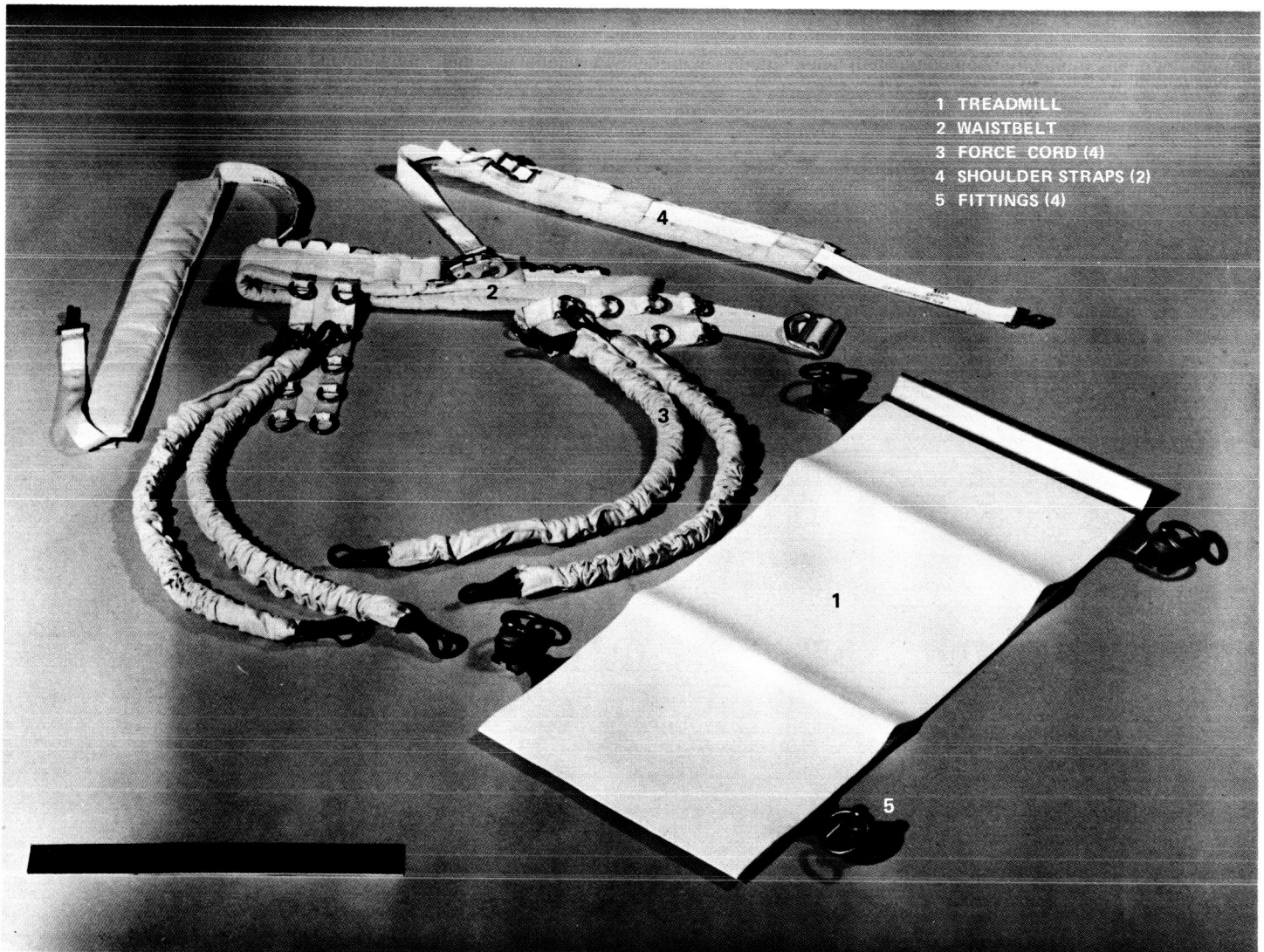


Figure 17.—Components of the treadmill exerciser.

Atmosphere Sampling

Project Engineer: Ai Shannon

The atmosphere-sampling system provides a method for obtaining cabin atmosphere samples to allow postflight evaluation of the gases for trace contaminant buildup (fig. 18). The main components of the air-sampling system are air-sampling bottles and the air sampler.

The air-sampling bottles are evacuated cylinders fitted with a diaphragm-type valve that is manually operated. On the top of the valve handle is a knurled diaphragm knob, which holds the diaphragm stem in place. A screw cap covers the end of the valve and is tethered to it.

The air bottles are evacuated preflight and are operated by rotating the valve handle full open and then full close. The time it takes to open and close the valve is sufficient to fill the cylinder with cabin gas.

The air sampler is a 10-centimeter (4-inch) diameter 8-centimeter (3-inch) long cylinder that contains 14 sample tubes filled with a tenax polymer, an absorbent used to trap compounds from the Shuttle cabin air. The air sampler also has a rotating orifice head that will select two sample tubes in each of seven positions. The eighth position is an off position. The sampler is put into operation by connecting the outlet to the vacuum vent on the waste management system and rotating the head to day 1, thereby selecting the first two sampling tubes. Air is then drawn through the orifice head (which regulates the air flow) and through the tenax absorbent. After sampling for a 24-hour period, the rotating head is then set for day 2, thus selecting the second two sample tubes. This procedure can be repeated for 7 days.

The air bottles and the air sampler are stowed in mid-deck lockers for launch and reentry.

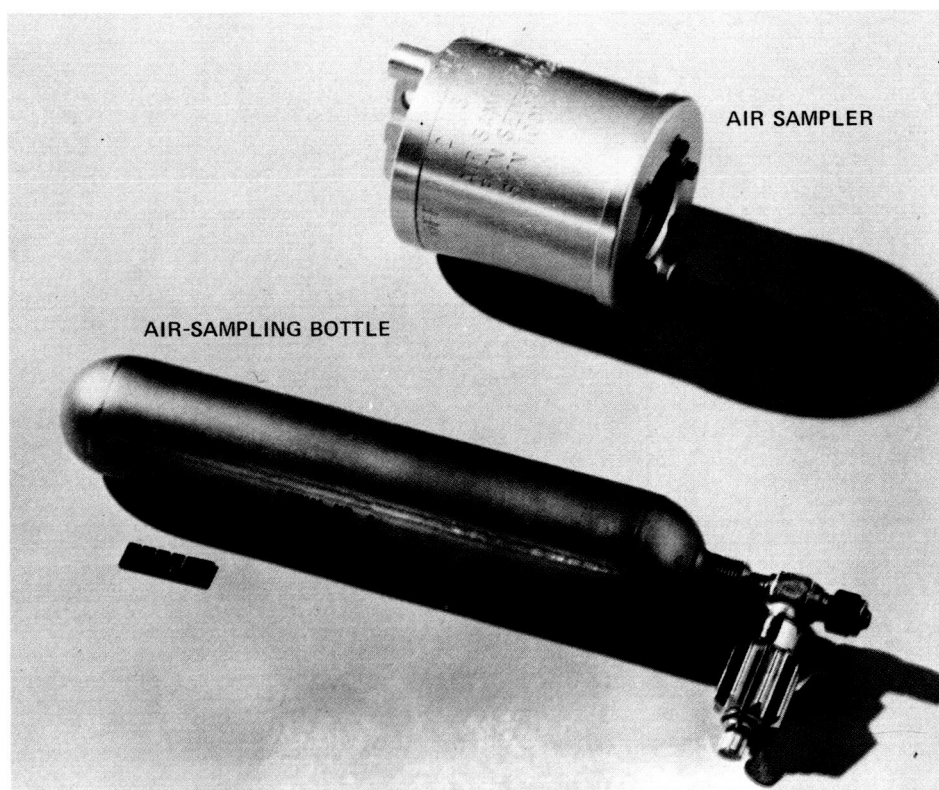


Figure 18.—Air-sampling system.

Ionizing Radiation Dosimetry System

Project Engineer: Herbert R. Greider

The ionizing radiation dosimetry system for the orbital flight tests and early Space Transportation System (STS) operational missions consists of several components (fig. 19).

Pocket ion chamber dosimeter: 0- to 200-millirad range

Pocket ion chamber dosimeter: 0- to 100-rad range

High-rate ion chamber dosimeter: 0- to 600-rad range

Crew passive dosimeter

Dosimetry pouch

Two pocket dosimeters and a crew passive dosimeter are placed in each of six pouches and, after orbit insertion, each of these pouches is attached to the Orbiter at a predesignated location. Two high-rate dosimeters are stowed in a locker and will remain stowed during flight unless emergency radiation conditions necessitate readout by the crew. Additionally, a crew passive dosimeter will be placed in a pocket on each crewmember's flight suit.

The ion chamber dosimeters are provided by the Experiment Systems Division and the crew passive dosimeters and the pouches are provided by the Medical Sciences Division. The pocket ion chambers enable a real-time readout of radiation exposure during flight if this information is considered necessary. Otherwise, a reading of the ion chambers will be made upon completion of the mission. A postflight analysis of the crew passive dosimeters will provide the capability to more accurately define the type of radiation contributing to the overall radiation exposure and thus make possible a more meaningful rem exposure determination.

The following is a list of additional biomedical equipment under development to support the multimission Shuttle Orbiter program.

Shuttle defibrillator
Life sciences Shuttle instrument eyeglass
OBS electrode applications kit
Intravenous infusion system
Patient/rescuer restraint system

Resuscitation system
Voice tape recorder
Instrumented exerciser
Carbon monoxide monitor

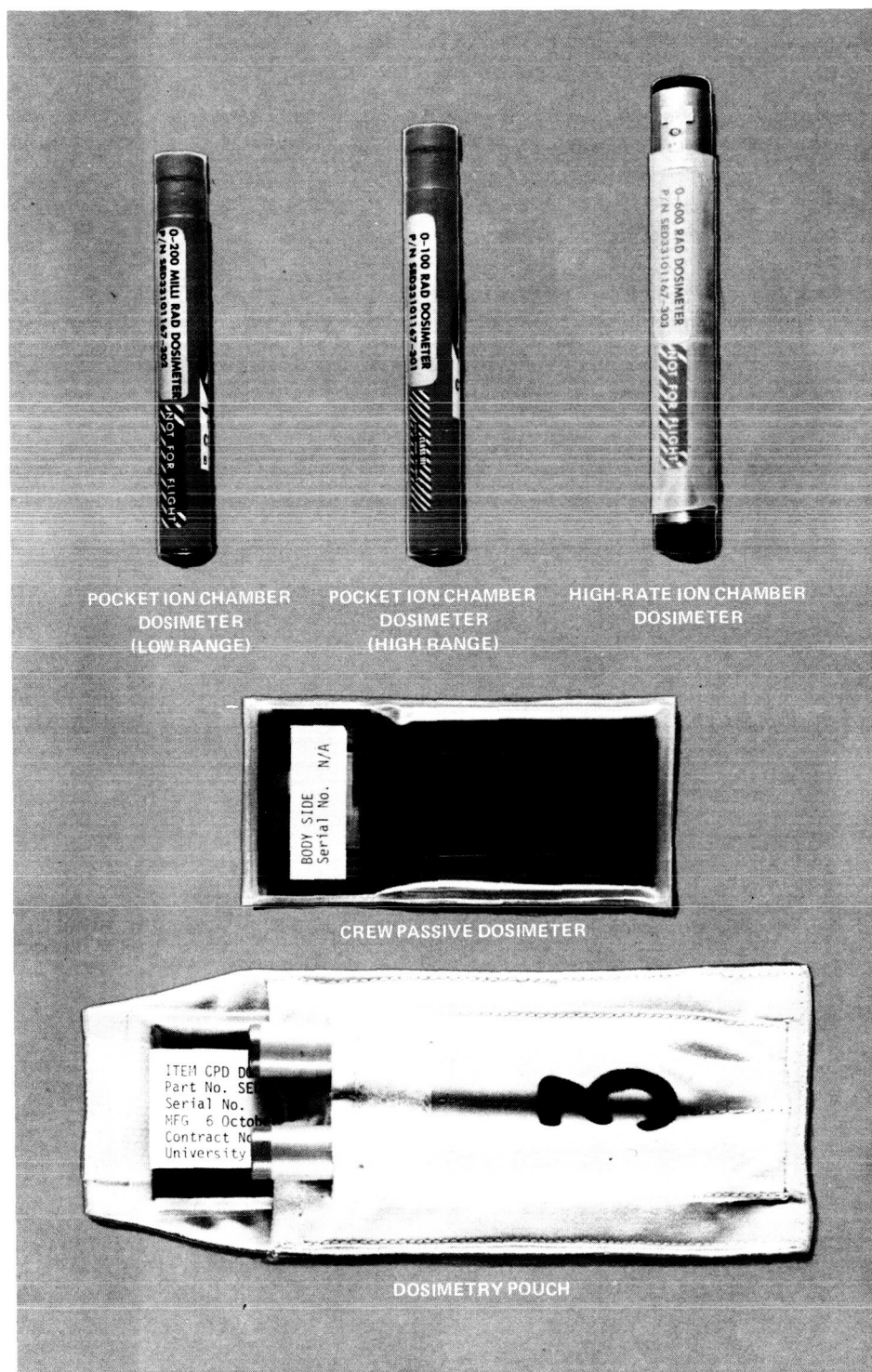


Figure 19.—Ionizing radiation dosimetry system.